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ORIGINAL PAPER

Knowledge and power in the technology classroom: a framework for studying teachers and students in action

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Abstract The purpose of this paper is to develop and illustrate an analytical framework for exploring how relations between knowledge and power are constituted in science and technology classrooms. In addition, the empirical purpose of this paper is to explore how disciplinary knowledge and knowledge-making are constituted in teacher–student interactions. In our analysis we focus on how instances of teacher–student interaction can be understood as simultaneously contributing to meaning-making and producing power relations. The analytical framework we have developed makes use of practical epistemological analysis in combination with a Foucauldian conceptualisation of power, assuming that privileging of educational content needs to be understood as integral to the execution of power in the classroom. The empirical data consists of video-recorded teaching episodes, taken from a teaching sequence of three 1-h lessons in one Swedish technology classroom with sixteen 13–14 years old students. In the analysis we have identified how different epistemological moves contribute to the normalisation and exclusion of knowledge as well as ways of knowledge-making. Further, by looking at how the teacher communicates what counts as (ir)relevant knowledge or (ir)relevant ways of acquiring knowledge we are able to describe what kind of technology student is made desirable in the analysed classroom.

Keywords Power relations · Secondary science education · Classroom interaction · Pragmatism

The aim of this paper is to develop and illustrate an analytical framework for exploring the simultaneous constitution of knowledge and power in science and technology classrooms, as such the paper is predominately set out as a methodological piece. The analytical

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framework makes use of practical epistemological analysis (Wickman and Östman 2002) as an analytical tool for describing teacher actions that involve a privileging of a certain educational content. Following James Wertsch (1991), we argue that such privileging of educational content can be understood as integral to the execution of power in the classroom. Thus, in our analysis we focus on how instances of teacher–student interaction that prioritise certain knowledge can be understood as simultaneously contributing to meaning making and producing power relations. In doing so, our work is situated within a European research tradition of Didaktik and as such focuses on the enactment of the content (which in itself is considered contigent) by teacher and students, and the potential consequences of this enactment (cf. Hudson 2007).

A deepened examination of power relations within the teaching of science and technology is partly motivated by these subjects' high status in society. They are portrayed as crucial both for the individual, in order to function in an increasingly technologically advanced society, as well as for society at large. Meanwhile these subjects find it increasingly difficult to attract interest among the youth of today (Teknikdelegationen 2010). In the Swedish context, where this research is carried out, it can further be noted that while the country is top-ranked on a number of equality indices and, in general, has a reputation that highlights its commitment to eradicating social inequalities, the labour market is still highly gender segregated (Alexandersson 2011) and, in university programmes, focused on the physical sciences and engineering men are substantially overrepresented (Nyström 2009). This somewhat paradoxical situation further motivates studies of how science and technology are constructed in the Swedish context, in and beyond the classroom. Hence, we argue that the investigation of how power and knowledge interrelate in moment-to-moment interactions in the classroom may provide additional clues to how micro-inequalities, adding up to patterns of exclusion in science and technology (Rosser 2012), occur in the classroom context. The research reported in this paper belongs to a larger project, where we focus on what both Swedish (Lindahl 2003) and international (Archer, DeWitt, Osborne, Dillon, Willis and Wong 2012) research identify as a key period for students' engagement in science and technology, namely that of the final years of compulsory schooling. In the broadest sense, the starting point for the project is that we in teaching and learning activities learn much more than the content knowledge being taught, we learn about norms and values and who we can and want to be in relation to those norms and values (Brickhouse 2001). In other words, any learning situation will also involve socialisation (Roberts and Östman 1998). In studies of science and technology education much focus has been placed on such socialisation processes, in particular in terms of which students are more easily socialised into the knowledge, norms and values of the disciplines and which students that are struggling and/or left outside, highlighting, for example, masculinity (Archer, DeWitt and Willis 2014), femininity (Brickhouse and Potter 2001), or social class (Jobér 2012). To at least some degree, such research has often conceptualised power (implicitly or explicitly) as structural, focusing on how different axes of power intersect with people's identity constitutions. However, following Foucault (1982), power can also be understood as not only embedded, but also embodied, in people's actions, thereby shifting the focus to how power is manifested in people's actions rather than mirrored in them. As argued by Marie Öhman (2010):

> A school subject's practices, traditions and customs are often deeply rooted in the teaching practice, and often regard content as natural and obvious. With the aid of [a Foucauldian power perspective], it becomes possible to study how the knowledge, norms and values included in an activity render certain ways of acting more

> reasonable and others less reasonable and thereby benefit certain ways of acting and being. (p. 406).

In correspondence with such a perspective, we in this article see the privileging of certain knowledge and skills as integral to the production of power in the classroom. In this article, it is the teacher's actions that are primarily in focus, as the teacher's enactment of a disciplinary discourse (Airey and Linder 2009) in important ways frame the students' possibilities for participation in science and technology, studied in relation to the classroom as an arena interactively constituted by teacher and students.

Situating the research problem

Within the fields of science and technology education there is a variety of research investigating classroom interactions and the connected roles and responsibilities of students and teachers. However, it can be noted that such research is still sparse within technology education, and that classroom based research has repeatedly been brought to the fore as an under-represented area in reviews of technology education research (Malcolm Carr et al. 2000; Alister Jones, Cathy Buntting and Marc de Vries 2013; Alister Jones and Judy Moreland 2003). For example, Jones, Buntting and de Vries (2013) argue that 'whilst a solid foundation now exists [for technology education research], it seems imperative that continued classroom-based research is undertaken if the field is to continue to move forward' (p. 208). Hence, the present study addresses issues crucial to the developing field of technology education, but given the present lack of classroom studies focusing on technology the research overview below will largely focus on the related field of science education. In the following we focus on research we share an empirical interest with (namely, research that explicitly focuses on the enactment of power science and technology classrooms). Lori Reinsvold and Kathryn Cochran (2012) and Dermot Francis Donnelly, Oliver McGarr and John O'Reilly (2014) both explore mechanisms of power in inquiry-based science classrooms. Reinsvold and Cochran (2012) described interactions between teachers and students in a third grade classroom, focusing in particular on how questions are associated with power dynamics. The authors found that teacher talk was twice as frequent as student talk and that students asked few questions. The classes observed followed an inquiry-based lesson format, but, despite this, the classroom discourse was typically controlled by the teacher, using traditional power strategies for doing so. Methodologically, the study is focused on analysing classroom discourse in relation to inquiry-based teaching, and the subject-matter of science is not problematised beyond whether an utterance is dealing with science subject matter or not. Donnelly, Garr and O'Reilly (2014) investigated direct (e.g. surveillance) and indirect (e.g. ownership of ideas) mechanisms of power in an inquiry-based science classroom. In agreement with earlier research they found that teachers' questions often were procedural in nature, seeking information about the students' progress in term of doing the experiment rather than their understanding. In accordance with Reinsvold and Cochran (2012) they also found traditional power relations between teachers and students to be maintained in both direct and indirect ways. However, the opposite can also occur: Antonia Candela (1998) showed that even within a traditional discourse format the discursive resources through which teachers exercise power are also available to students. For example, in the classrooms she studied the students contradicted the teacher's explanations, evaluated the teacher's or students' explanations or refused to participate in the discussions. She concludes that 'students'

participation in classroom discourse is active and complex and does not always follow the teacher's attempts to control course content' (p. 156). While set in a science context the focus of the analysis is predominantly on the discursive dynamics of the classroom, not explicitly on how science is constructed. In order to encourage active participation in learning and foster an authentic learning of scientific practices researchers have sought to implement new participation structures in science classrooms (Ford and Forman 2006). Similarly, Lindsay Cornelius and Leslie Rupert Herrenkohl (2004) bring the interrelation between participant structure and disciplinary thinking to the fore, in a study of how a new participant structure may change both social interactions and prompt scientific thinking. They analysed classroom interactions starting from three aspects of power and then moved towards how these aspects not only define social relationships but also the intellectual, disciplinary relations between the students and the concepts being studied. For example, they conclude that having ownership of ideas (one of the power aspects analysed) both shifts power from the teacher to the students and closes the distance between the student and the scientific concepts, thereby creating a sense for the student that they are creators of their own ideas. However, several studies have also indicated that the implementation of new participant structures can be problematic from the perspective of fostering disciplinary conversations, for example, both Julie Bianchini (1997) and Daniel Shepardson (1996) found that students were more often involved in negotiations about group processes and procedural aspects than the disciplinary content. A study of formative assessment in primary school technology teaching also came to similar conclusions, arguing that teachers' lack of detailed understanding of technological practice led them to focus on social and managerial aspects rather than technological procedures and concepts (Moreland, Jones and Northover 2001). However, the authors do not discuss what can be considered technological procedures and concepts in any depth.

In summary, research shows that traditional power structures are often maintained even in reform-based classrooms (Carlone 2004), which should not come as a surprise given the strength of the traditional schooling discourse (Carlone et al. 2011) as well as the strength of disciplinary traditions (Roehrig and Kruse 2005). However, it is also most certainly possible for students to exercise some control of the content taught even within traditional classroom formats (Candela 1998). The extent to which the negotiation and constitution of the disciplinary content is taken into account in these studies of issues of power in science and technology classrooms varies, but the focus is often more heavily placed on analysis of general participant structures rather than disciplinary-specific knowledge, values and norms. While taking their grounding in a variety of different theoretical approaches a common trait of the studies is that the analyses start from an analysis of the power relations/interactions in the classroom. Consequently, while set in science and technology classrooms, what participating in a discipline-specific discourse consists of is to some extent taken for granted, and the construction of school science/technology as such not problematised substantially. As such, there is a lack of studies providing a methodology for studying power that take the situatedness of the science and technology classroom into consideration. In this paper we approach the interconnectedness of power relations and disciplinary-specific knowledge, values, and norms from a different perspective, by taking a knowledge-based framework as our starting point. In doing so, we aim to create a more fine-grained understanding of what is made possible and desirable in science and technology classrooms in terms of the construction of disciplinary-specific knowledge, values, and norms.

Research problem

The purpose of this paper is to develop and illustrate an analytical framework for exploring how relations between knowledge and power are constituted in the technology classroom. As such, we predominantly seek to make a methodological contribution to the field of science and technology education. In addition, the empirical purpose of the paper is to explore how disciplinary knowledge and knowledge-making are constituted in teacher–student interactions.

Theoretical grounding

Our work is founded in a pragmatic approach to meaning-making, where classroom practices regarding both content and form are understood as reciprocally constituted by teachers and students. Central to this approach is that both participants and content are constituted and become someone/something in the situated meeting, thus, individuals and context/discourse are viewed as a whole where one does not precede the other (Dewey and Bentley 1949/1991). As such, individuals' relations to each other and the context are considered to be transactional (Östman and Öhman 2010). Such transactions involve participants acting upon the actions of other participants—in line with a Foucauldian understanding of power—and in doing so structure the field of possible actions of others (Foucault 1982). A key occurrence in any classroom is the teacher's guiding of students towards certain knowledge and skills. This can be conceptualised in terms of privileging—a term that draws attention to that the enactment of a teaching content always involves valuations and judgments—as some aspects are regarded as important and others disregarded (Wertsch 1991). Knowledge privileging is ultimately concerned with what is made possible and desirable in a certain context in terms of the inclusion of certain knowledge and views of knowledge and the exclusion of others. This view of knowledge privileging is in line with Foucault's understanding of discourse as comprised of that which is possible to speak about (Foucault 1982). In other words, such privileging can be understood as integral to the execution of power in the classroom, even though, as argued by Leif Östman, Marie Öhman, Eva Lundqvist and Malena Lidar (2015), this connection has not been extensively explored. However, several scholars, within different fields, for example, Mikael Quennerstedt (2008) (physical education), Östman, Öhman, Lundqvist and Lidar (2015) (science education), and Todd May (2011) (philosophy), have argued that Foucault's work is not only in line with pragmatism, but also provides a way to strengthen the transactional approach. Öhman (2010) elaborates:

> Placing power in relation to the transactional perspective means not presupposing that power is something given, but something that is examined as it is manifested in a certain context. With the aid of Foucault's power perspective we can thus explain how students' actions are both facilitated and restricted in a teaching situation, and thereby determine what these processes look like and how they govern an individual's way of acting and being (p. 397).

In the following we introduce some main characteristics of a Foucaldian conceptualisation of power, before moving on to how these—as integrated into transactional approach to meaning-making—are operationalised in our analysis.

Central to Foucault's conceptualisation of power is the idea that power exists in a network of micro powers, rather than being located in a few individuals and organisations

(Foucault 1980, p. 198). Thus, Foucault is trying to dispel the idea that power is only something some people exercise, instead he insists we are all caught in its 'net-like organisation'(Foucault 1980, p. 98). He argues that in today's Western society, power is no longer practiced primarily through the infliction of penalties but rather by using surveillance. By being observed, or thought to be observed, the individual starts to act in accordance with the expected behavioural norm, and has, thus, internalised this behaviour. This internalisation is conceptualised in terms of self-governance, that is, how people 'choose' to act in line with institutionalised practices, such as schooling, without explicit coercion (Foucault 1982). Furthermore, the fact that power relations exist everywhere implies that they are both repressive and productive. In other words, power relations are a precondition for our subjectivities, individuals cannot exist outside them. Thus, power relations not only make us submit to certain norms for behaviour, they are productive in that they make subjectivities possible. Öhman (2010, p. 397) explains: 'individuals can thus be regarded as an effect of power at the same time as they create power through their actions, i.e. individuals set power in motion through their actions'. Drawing on this very brief depiction of some main characteristics of a Foucauldian conceptualisation of power we would like to bring three affordances to the fore that we see as particularly pertinent for science and technology education research:

1. Conceptualising power as productive/producing rather than purely restraining/oppressive gives a theoretical vantage point for thinking about the possibilities of the science/technology classroom as a vehicle for social justice and viewing the subjectivities constituted in those classrooms not only in a negative-critical light (Bazzul 2014).
2. By interconnecting power and knowledge it becomes possible to study how power operates in the very minutiae of everyday science/technology classroom actions, thus, troubling the taken-for-grantedness of such actions. One example of such a 'taken-for-grantedness' that this premise allows for a detailed analysis of how students act upon teacher actions and vice versa (Öhman 2010).
3. The concepts of governance/self-governance provide a way to think about which student subjectivities are made possible and desirable within a specific classroom context in relation to a specific subject matter. In particular, the concept of self-governance moves the focus from teachers' governance as unilateral to acknowledging the function of students' self-regulation. Further, it brings to the fore how a teacher's teaching repertoire may include such appeals to students' self-governance (Östman, Öhman, Lundqvist and Lidar 2015).

In this paper our main focus is on the second of these affordances, and in the following section we develop concepts of particular importance to this paper further and discuss how these are operationalised in our analysis.

Analytical framing

A starting point for our analysis is that the learning of concepts and skills is intertwined with the learning of values and of how we understand ourselves in relation to the world (Popkewitz 1987). Douglas Roberts and Leif Östman (1998) discuss this in terms of how learning of content always implies socialisation, that is, privileging of specific knowledge and skills establishes norms for rational ways of acting and being within a certain practice. Thus, the systematic inclusions and exclusions of content, which is at the very heart of

teaching, involves the enactment of values in the process of choosing (Östman, Öhman, Lundqvist and Lidar 2015). However, the degree to which pragmatism has been able to explicate the workings of power within the studied practice has been questioned (Östman, Öhman, Lundqvist and Lidar 2015). For Foucault, on the other hand, the knowledge within a practice is intimately linked to power. His work has, thus, been suggested as a way to strengthen this aspect of the transactional approach (see also, Quennerstedt 2008). Foucault argues that power and knowledge are always intertwined and can never be separated: there is no power relation without the correlative constitution of a field of knowledge, nor any knowledge that does not presuppose and constitute at the same time power relations' (Foucault 1977, p. 27). Thus, any knowledge claim is simultaneously constitutive of power relations that make this particular knowledge considered legitimate and possible, and vice versa, techniques of power aim to control knowledge (Foucault 1977). In an empirical study Jennifer Gore (1995) has explored the potential of Foucault's analysis of power for investigating pedagogical sites. From her empirical analysis she concludes that there appears to be a continuity in the functioning of power relations in pedagogy, across, seemingly, very different contexts. Central to her analysis is how, in the regime of pedagogy, the workings of power and knowledge are integrated, albeit not interchangeable, hence the concept *power/knowledge*: 'sometimes [the techniques of power] functioned in the construction of knowledge; at other times, they functioned in the construction among participants in the various sites; at yet other times, they functioned in the construction and maintenance of particular subjectivities' (p. 183). In exploring the workings of power/knowledge she has distilled eight 'techniques of power' from Foucault's work, which she employs in order to document exercises of power, as carried out at a micro-level. The techniques of power she finds are surveillance, normalisation, exclusion, classification, distribution, individualisation, totalisation, and regulations (Gore 1995). While all techniques of power are important in order to give a comprehensive documentation of the workings of power, normalisation and its reverse exclusion are arguably at the very core of any pedagogical practice. Gore (1995) explains:

> Educating is naming, communicating, and upholding norms—norms of behaviour, of attitudes, of knowledge. Here, the productive exercise of power through normalising techniques would seem to be a fundamental precept of pedagogical endeavour. That is, unless teachers can effectively exercise power to present and reinforce particular norms, teaching would not be a purposeful endeavour (Gore 1995, p. 172).

Hence, normalisation takes place through the, often subtle, delimiting of appropriate behaviour. On the flipside, exclusion describes the technique for tracing the limits that define what is seen as different. Such techniques are pervasive in education, and Gore (1995) points out that it is likely that many negative experiences and memories of schooling are the result of processes of exclusion. In our application of the Foucauldian power perspective we are zooming in on the complementary techniques of normalisation and exclusion, which need to be understood together. The reason for this delimitation is the centrality of these particular techniques of power in pedagogical practices. While there can never be normalisation without exclusion, and vice versa, we have for analytical purposes tried to separate the two. In our analytical operationalisation of the concepts we follow Gore's description of normalisation as 'invoking, requiring, setting or conforming to a standard—defining the normal' (p. 171) and of exclusion as marking the 'reverse side of normalisation—the defining of the pathological' (p. 173). Gore's analytical operationalisation of Foucauldian power perspective in the context of education through the concepts of normalisation and exclusion does not, however, explicitly deal with the content being

taught, which, at least in part, is a consequence of her aim to inquire into power relations across diverse pedagogical sites. Here we make use of Gore's concepts of normalisation and exclusion as a way to specify potential consequences of teaching in terms of micro-level exercises of power. Teaching is here perceived as teacher actions that have a guiding function for students regarding what counts as valid knowledge and valid ways of acquiring knowledge within the practice of technology teaching (Lidar, Lundqvist and Östman 2006). Malena Lidar, Eva Lundqvist and Leif Östman (2006) have coined the expression 'epistemological moves' to describe such actions and developed an analytical approach called Epistemological Move Analysis (EMA) based on a transactional perspective on learning. From this perspective, teacher actions can be thought of as directions that contribute to the actions of one or more students being enhanced, re-oriented, or rectified in some directions. This direction is a phenomenon that must be identified and described as a unit including both teacher actions and student responses. In EMA this is called specific moves in a language game, moves that communicate to the students what counts as knowledge and what counts as relevant ways of acquiring knowledge in this particular practice or situation. In our analysis we approach these actions through EMA, aiming to capture the teacher's epistemological moves. The focus in EMA can be thought of in terms of how the perpetual chain of teacher action upon student action upon teacher action (Foucault 1982, p. 340) governs students' actions and what consequences this has for what the students will learn. The aim of our analysis is to demonstrate how power operates in terms of knowledge; in technology being created through normalisation, by embracing certain content, and by demarcations and disarticulations regarding others. The application of EMA focuses and delineates the analysis to that which emanates from the enactment of the teaching content, which is elaborated further in the next section. Next we will give a short description of the empirical data made use of before moving on to how the analytical affordances created in the intersection of Foucault and EMA are operationalised in practice in our analysis, and hence, how our analytical framing is developed further and refined in the encounter with empirical data.

Research context and data collection

As outlined earlier, this paper will illustrate the use of an analytical framework, developed in order to explore how power and knowledge are constituted in the classroom. In doing so, we make use of video-recorded teaching episodes, taken from a teaching sequence of three 1-h lessons in one Swedish technology classroom with sixteen 13–14 year old students. The topic of these lessons concerns 'solid and stable constructions', a part of the core content of the technology syllabus for year 7–9 ("Swedish Technology Curriculum," 2011).

The Swedish school subject technology has been influenced by traditions from when the subject was a purely vocational elective at the upper secondary level in the 1960s and 1970s. In 1980 technology as a school subject was reformed into what can be described as an applied natural science course, compulsory for everyone. In the process of developing the new compulsory school subject the 'vague' identity of technology as a subject became evident, especially in relation to science (Hallström, Hultén and Lövheim 2014). This vagueness has also been recognised internationally (Jones, Buntting and de Vries 2013). Today scientific aspects of technology still become foregrounded in technology teaching in Swedish classrooms (Klasander 2010). The school subject technology, as described in the

current Swedish curriculum, aims to improve students' awareness and understanding of technology in order to make the students more confident and able to orient themselves in a society strongly influenced by technology. However, the education is also meant to invoke an interest for technology as well as improving students' skills to manage technological challenges ("Swedish Technology Curriculum" 2011).

During the lesson sequence concerned with 'solid and stable constructions' the pupils worked with construction of models of bridges, which is a very common activity when working with this topic in Swedish classrooms. Prior to the construction of models of bridges the students had been working with truss structures (a triangular structure used to make constructions more stable), a structure they are now expected to make use of in the building of model bridges. The teacher is an experienced science and technology teacher, who can be described as devoted and actively engaged with her pupils. The teacher described the outline of the lesson sequence as follows: In the first lesson the pupils were expected to make a plan for the building of the bridge, in the second they were expected to build the bridge, and at the end of the third lesson the bridges would be tested and evaluated. The instructions for the building of the model bridges were relatively open, giving specifications for various measures the bridges are supposed to fulfil (e.g. the bridges should have a span of 20 cm). The instructions also specify that the bridges should be 'nice to look at' and be capable of carrying a load of 5 kg, the latter is what will be tested at the end of the lesson sequence. For the building of the model bridge, the students have been given a limited amount of building material, consisting of fifty lolly sticks, a glue gun, a 2 m long string, a piece of cardboard, and two 50 cm long sticks. Given that we are interested in analysing teacher—student interactions we have in this paper focused on the second lesson in the teaching sequence, where the students are working in smaller groups as the teacher moves between them. This lesson started off with the teacher talking about administrative issues for a few minutes and reminding the students that some of them have not handed in earlier assignments. Thereafter she called attention to the specifications of the bridge given in the instruction (e.g. how long the span should be). She also specifically pointed out that this is the lesson when they are expected to build. After the introduction by the teacher, the desks were rearranged into islands and boxes with materials were collected by each group. During the remainder of the lesson the students worked in smaller groups with the construction of the bridges, while the teacher walked around in the classroom, approaching different groups to give guidance (Table 1).

Prior to the video-recording, the students and their guardians had been given information about the research project and had given consent to participation. All names in the paper are pseudonyms and for the sake of anonymity no contextual information about the school is given.

Analytical process

The analytical process consisted of several stages: first a descriptive stage, a second stage guided by epistemological move analysis (Lidar, Lundqvist and Östman 2006) and a third stage concerned with how knowledge and power are constituted and related in the meaning-making processes on an interpersonal micro level:

1. First stage: micro-analysis of utterances
2. Second stage: identifying epistemological moves.

Table 1 Overview of transcribed material, with time and length of the transcribed episodes

Group 1		Group 2	
31:00–34:00	3 min	27:42–29:06	1 min 24 s
37:50–40:10	2 min 20 s	42:30–43:55	1 min 25 s
46:00–46:20	0 min 20 s	48:16–49:36	1 min 20 s
50:00–54:40	4 min 40 s		

3. Third stage: analysing identified epistemological moves in relation to normalisation-exclusion.

The first analytical stage had several distinct steps. First, we reviewed the video recordings in conjunction with the transcripts and paid special attention to sequences where the teacher interacted with Group 1 (four sequences) and Group 2 (three sequences) in our empirical data. Then, two authors described the function of every utterance and gesture (both the teacher's and the students' utterances) in the sequences of teacher–student interaction. This empirically driven analysis aimed to create an overview of the data and resulted in the construction of six preliminary themes (such as 'explicit talk about expected behaviour of teacher and students' and 'technological content knowledge'). The second stage was to merge the preliminary themes with the identification of epistemological moves with a special focus on what the teacher said, basing our discussion on an earlier coding scheme made by Lidar, Lundqvist and Östman (2006) (Table 2):

At this stage, we let a third author code the teacher's utterances on all seven sequences, using our new coding scheme that was based on epistemological moves. Here it is highly important to point out that even though we focus on the teacher's utterances these were always coded *in relation* to the students' responses, considering the interaction as a language game where people create meaning together. Hence, an utterance always needs to be seen in relation to its response and cannot be coded as an independent entity. In the empirical material we identified four out of the five epistemological moves described in Lidar, Lundqvist and Östman (2006). In addition, we have analytically separated the moves into two types depending on the content/direction of the moves. Categorised as the first type are moves connected to the completion of the building task (and the associated meaning making), we call these *knowledge moves*. The second type of moves explicitly expresses norms and expectations for student and teacher actions in relation to knowledge

Table 2 Overview of epistemological moves, from Lidar, Lundqvist and Östman (2006)

Confirming	Confirms that the students are recognizing the right phenomenon and events or confirms that the students are doing a valid experiment by agreeing with what the students say or do
Re-constructing	Directs the students to recognize as important and write down 'facts' they already have noticed, but not perceived as valid
Instructional	Gives the students a direct and concrete instruction on how to act to be able to see what is worth noticing. In other words, what the students need to do to find the solution
Generative	To enable the students to generate explanations, the students are directed to summarise what they feel are important facts to pay attention to
Re-orienting	Points out that there can be other properties worth investigating. Directing the students to take another direction than the one they have already started on

construction, we call these *knowledge making moves*. While previous research has alluded to the possibility of specifying epistemological moves depending on content/direction (Lundqvist, Almqvist and Östman 2012), such a specification has not been employed as an analytical tool. A summary of examples of epistemological moves is found at the end of the Results section.

In the third stage of the analysis, the potential consequence of teaching in terms of micro-level exercises of power was specified using Gore's concepts of exclusion and normalisation. In doing so, we seek to unveil how mundane technology classroom activities render certain ways of acting more reasonable and others less reasonable. By placing the analysis of normalisation/exclusion subsequent to the EMA this analytical stage is delineated to dealing with particular workings of power, namely those related to the enactment of the teaching content. As previously discussed it is not always possible to distinguish between normalisation and exclusion, as any kind of normalisation also implies a simultaneous exclusion and vice versa. We have therefore chosen to categorise the teacher utterances into the two rather broad categories of 'Foregrounding normalisation' and 'Foregrounding exclusion'. When an utterance is categorised as foregrounding normalisation the utterance explicitly normalises a certain kind of knowledge/action, whereas it potentially excludes a whole range of knowledges/actions (some more likely than others). Similarly, an utterance that is categorised as foregrounding exclusion, explicitly excludes/pathologises a certain knowledge/behaviour (e.g. the construction of a vaulted bridge), but it is not clear which knowledge/behaviour that is desirable (e.g. a number of other types of bridge constructions are potentially possible). By trying in this way to operationalise a Foucauldian power perspective on a micro-level analysis we are, like Öhman (2010), also seeking to contribute to the scholarship that makes use of the methodological aspect of Foucault's work, by showing how the privileging of teaching content functions in directing knowledge and knowledge-making, which in turn governs classroom actions and is integral to the execution of power.

Results

In the following section we present instances of student–teacher interaction that foreground either Normalisation or Exclusion. In doing so, we exemplify how normalisation and exclusion are occurring in the studied classroom, by using epistemological moves as an analytical entrance point to how knowledge is privileged.

Foregrounding normalisation

In the following section we illustrate how normalisation occurs in the studied classroom, how knowledge is privileged within this technique of power. This is done through a number of excerpts from the video-transcripts, each illustrating how different kinds of epistemological moves contribute to normalisation.

When Excerpt 1 starts off, the three students in Group 1 discuss how to build the bridge with the lolly sticks on their desks. Carla has the material in front of her and expresses an elaborate plan for how to continue, but both Bryan and Ahmed question this plan. None of the three students ask for any help or guidance, but when the teacher passes by she approaches the students' desks and asks 'How is it going?', a question that can be interpreted as a rather typical teacher surveillance (Gore 1995). The dialogue continues:

Excerpt 1

1. Teacher: How is it going?
2. Ahmed: eh we [inaudible]
3. Carla: no, we gonna [inaudible]
4. Bryan: and then
5. Carla: (mumbling) no it can't be that way
6. Bryan: or this way
7. Carla to teacher: look, I have it this way
8. Ahmed: I know, this way
9. Carla: then we have triangles all over
10. Ahmed: one down there one up there so, one down there and one up there
11. Teacher: How are the lolly sticks the strongest? From which side?
12. Carla: so? ((illustrates with a lolly stick))
13. Ahmed: yes, so…or?
14. Teacher: I won't answer that, discuss it
15. Ahmed: sigh ah

In this dialogue the two later teacher questions, in line 11, function as *generative knowledge moves*, in that they draw attention to what is worth noticing in this situation (i.e. properties related to the strength of the lolly sticks). By drawing attention to specific principles for construction this line of questioning functions as the normalisation of certain knowledge; which knowledge that is important for a technology student to focus on.

The third teacher utterance, 'I won't answer that, discuss it' in line 14, we have categorised as a *generative knowledge making move.* A knowledge making move is an epistemological move that explicitly privileges certain ways of constructing knowledge and gives directions for students' and teachers' roles in this knowledge construction. Thus, knowledge making moves are concerned with the preferred ways to construct knowledge in this technology classroom (and the teacher's and students' roles in this knowledge construction). This explicitness is in contrast to how, for example, generative knowledge moves can implicitly model a certain way of constructing knowledge (the teacher questions in line 11 could be said to model a kind of question the student ought to ask themselves during the building process). The utterance in line 14 becomes both a form of normalisation of a certain teacher behaviour and at the same time a form of exclusion of student behaviour (especially in the light of continuation of the dialogue); the students are not expected to ask the teacher this kind of question in this context but to find the solution primarily by themselves.

How finding the solution independently is given precedence in this classroom is further reinforced as the student–teacher dialogue continues, when Bryan prompts the teacher to give them a clue:

Excerpt 2

15. Ahmed: sigh ah…
16. Bryan: give us a clue
17. Teacher: I GAVE you a clue. Who is correct, Ahmed or Carla?
18. Bryan: Ahmed
19. Teacher: How come? Because he is your friend or because you believe in what he said?
20. Ahmed: I don't know
21. Bryan: no, because I said that [inaudible] becomes like this…

22.Carla: no, but if I do it like this, then it becomes a triangle so it will hold [the weight]
23.Ahmed: no
24.Teacher: From which angle do you place a load on the triangle? From which angle is a triangle the strongest?
25.Bryan: [inaudible]
26.Teacher: Like this or like this? ((illustrates with her hand on the lolly sticks in C's hands))
27.Teacher: Now I have helped you so much, now I'll leave before I say too much
28.Carla: a triangle is strongest like this ((illustrates with her hand)
29.Ahmed: ah, but she said like this or like this ((illustrates with her hand))
30.Carla: Well either over here, or like this
31.Ahmed: okay let's do this, eh, we did it right or?

In this continued dialogue the teacher uses generative knowledge moves again. The first question (line 17) was coded as a generative knowledge move, in that it shows the students what was important to pay attention to in this context: Ahmed and Carla have given different answers to the same crucial question and one of them is correct. However, the utterances 'Who is correct, Ahmed or Carla?' and 'Because he is your friend or because you believe in what he said?' (line 17 and 19) rather expresses an exclusion in this context, which we will elaborate on further in the next section. In line 19 the teacher expresses a preferred way for student B to construct knowledge, a knowledge making move: since Ahmed and Carla have given different answers Bryan should reason about which perspective was right. Afterwards, in line 24 and 26, the teacher's generative knowledge moves illustrate what is most important to pay attention to (how you load the triangle)—at the same time these actions exclude other geometrical shapes than triangles. Typical of such a conversation is that both teacher and students express and normalise some perspectives or some solutions as more appropriate than others, in contrast to how their task is framed as 'open'. In line 27 the teacher's generative knowledge making move highlights that the earlier generative knowledge moves should be conceptualised as 'help', something she could give too much of. This is reinforced further towards the end of the lesson when the teacher visits the group for the third and last time and says:

Excerpt 3

32. Teacher: Or did you want me to say if it's good or bad?
33. Bryan: yeah
34. Teacher: …because I'm so cruel that I won't do that. Don't you know me better than that?
35. Ahmed: yes

In lines 34 the teacher uses a re-orienting knowledge making move to communicate that the students should not expect her to give them explicit instructions, and, furthermore, explicitly normalises this behaviour in the second utterance of line 34. Even though the teacher describes her own performance to not tell if the students work 'is good or bad' as 'cruel' she normalises this action with the knowledge making move 'don't you know me better?'. By this utterance she signals that the students already should have been normalised into not asking such questions.

Another way to contribute to normalisation is through confirming moves. In this technology classroom the teacher uses confirming knowledge moves to acknowledge that the students are progressing with their building in a valid and fruitful direction and by

agreeing with them. In the excerpt below the teacher confirms that the students' plan of action for the building is a valid one, giving them the approval to proceed as planned:

Excerpt 4

36. Bryan: but then we can do like this: we can place one here, and one here, and one here and one there.
37. Teacher: yes, you can do it like that.
38. Ahmed: hey, this is going to be great

Foregrounding Exclusion

The following section illustrates how exclusion occurs in the studied classroom, that is, how teacher utterances explicitly exclude/pathologise certain knowledge and ways of knowledge-making, but without making clear which knowledge/knowledge-making processes that are desirable. When Excerpt 5 starts off, the four students in Group 2 discuss how to build the bridge. Diana has two lolly sticks in her hands and tries to come up with ideas, but as a group they seem to be very unsure of what to do. Evan and Frank have very curled body positions and Diana says in passing: 'I really have no idea'. The teacher seems to notice this hesitation because she turns up very swiftly and asks them 'How is it going now?'. When Diana tries to illustrate a vaulted bridge with lolly sticks and points towards their collective sketch the teacher says immediately:

Excerpt 5

39. Teacher: Wait a minute! It's supposed to have legs, the bridge. Where are the legs? It's supposed to have legs. Where do you have those?
40. Diana: …well, the legs are… but look here, they will be laying down…
41. Teacher: Will they be laying down, the legs?
42. Diana: Cause then it will be so much more stable… and then they will be laying down, and the vault-thingy will be…
43. Teacher: Yeah…
44. Diana: and then it will go like that in both places
45. Teacher: okay
46. Diana: and then the boat can pass under there
47. Teacher: Have you thought about how a vaulted bridge looks? Have you ever observed a stone bridge?
48. Diana: Mm
49. Teacher: How are the stones positioned?
50. Diana: They are, how the hell can you explain (shows with her hands)
51….
52. Diana: [inaudiable] such a panic, I just have to [inaudiable]
53. Teacher: Are you able to place lolly sticks like that, so that it becomes strong?
54. Diana: Yes, that's what I'm thinking'cause [inaudiable]
55. Evan: That's really not what we're supposed to do [inaudiable], you know

The teacher starts with a re-orienting knowledge move (39) where she communicates that there can be other ways to build the bridge worth investigating. By moving the students' away from their suggested vaulted bridge construction, towards another, preferred way of construction, the teacher's actions are directed towards an adjustment of what the students are doing. Through a series of utterances (47, 49, 53) she shows the students the impossibility of constructing a vaulted bridge given their constraints in terms

of materials. These utterances can all be understood as re-orienting knowledge moves, that is, epistemological moves that take the students' construction or plan for construction in a different direction than the one they have started on (Lidar, Lundqvist and Östman 2006). Thus, a re-orienting move is different from a generative move, in that it aims to change the present course of action, rather than narrowing down the possible space of action as generative moves do by highlighting what the students' ought to pay attention to. By repeated re-orienting moves the teacher is here, through a series of teacher actions upon student actions, creating an exclusion of the principle for construction suggested by Diana. However, she does not explicitly guide their attention to another principle for construction, the teacher utterances simply exclude the building principle suggested by the students, hence, we have coded this exchange as exclusion rather than normalisation.

It is also important to notice that Diana keeps to her vaulted bridge plan throughout the entire student–teacher exchanges, and it is her descriptions of the vaulted bridge construction that the teacher continuously acts upon in the series of re-orienting moves. This goes on until the teacher utterance in line 53 is met differently by Diana and Evan. In the interaction between the teacher and Diana this utterance becomes a generative move, in that Diana here confirms the appropriateness of the vaulted bridge construction, albeit focused in a certain direction ('remember the legs') by the teacher. Evan instead meets the teacher utterance in line 53 as a re-orienting move, acknowledging that a vaulted bridge is not a possible construction given the limitations in materials, and it is this interpretation of the teacher utterance that takes precedence in the group as they give up the vaulted bridge construction.

Throughout the empirical material, teacher utterances explicitly referring to how the students ought or not ought to construct knowledge are abundant. Such utterances have not been identified (or at least not classified) in earlier work employing the tool epistemological moves, such as Lidar, Lundqvist and Östman 2006 or Karin Rudsberg and Johan Öhman (2010). As previously described, we have chosen to denote utterances concerned with the preferred ways to construct knowledge (and the preferred roles of the teacher's and students' roles in the knowledge construction) as knowledge making moves. For example, in line 17 and 19 in Excerpt 2 the teacher's questions are coded as instructional knowledge making moves since these questions communicate a preferred way for student B to act upon (the tone of the teacher's utterance clearly communicates which choice is appropriate):

Excerpt 2

17. Teacher: I GAVE you a clue. Who is correct, Ahmed or Carla?
18. Bryan: Ahmed
19. Teacher: How come? Because he is your friend or because you believe in what he said?
20. Ahmed: I don't know
21. Bryan: no, because I said that [inaudible] becomes like this…

As mentioned before, this action normalises a certain way of reasoning about which perspective is appropriate. However, the instructional knowledge making move in line 19 'pathologises' (partly through an ironic voice when she asks for an argument) the behaviour of choosing Ahmed only because he is his buddy. In this context this action is constructed as an invalid reason for agreeing with someone, hence excluding this reason as appropriate in the technology classroom. Bryan also contradicts this claim from the teacher, in line with the expectation. Another example of a knowledge making moves that

both normalise and exclude is from the other group with four students (in this case it is a re-orienting knowledge making move):

Excerpt 6

55. ((Evan has fetched a model bridge, built of lolly sticks, from the window sill and the group is looking at the model bridge together.))
56. Teacher: What are you doing? Are you stealing ideas?
57. Diana: Yeah, kind of [inaudiable]
58. Teacher: But that one's useless.
59. Frank: Yeah, I know, completely useless.
60. Teacher: For starters they've probably got a hundred lolly sticks.
61. Evan: What?
62. Teacher: Yes, or it's at least… well, this is almost fifty and then they've got underneath ((interrupts herself and talks to another group)). So think about that and then [inaudiable]
63. Evan: [inaudiable]
64. Teacher: But you have to start! You haven't done anything!
65. Diana: I feel that I've got a headache so I don't know what I'm supposed to do.
66. Evan: But, we've said a thousand ideas.
67. Teacher: Well, listen up, it has to be this long here, and then you have to decide—will you have 40 cm that you then place sticks on if you do it like this or however you do it, or will you use these that you glue together into 40 cm and then you can have it in this direction or that direction and, remember, we talked about which direction was the strongest.
68. Evan: [inaudiable] lies down [inaudiable]

This excerpt comes from the end of the lesson when the teacher visits the group for the fourth (and last) time. The students are still struggling with agreeing on any solution and Evan has fetched a bridge, which is built of lolly sticks, from the window sill. The dialogue starts with the teacher making two re-orienting knowledge making moves (56, 58) that concern the students' examining of the window-bridge: she calls their action 'stealing ideas' and the window-bridge in Diana's hands 'useless'. These re-orienting knowledge making moves are both excluding since they make the students' observing of the ready-made bridge abnormal in this context. After that she makes generative knowledge moves (60, 62) that enable the students to generate explanations for how the bridge is useless (in this context). The following line (64) is an additional example of how a re-orienting knowledge making move that normalises (the process of building) but foremost excludes the students' lesson-long discussion as abnormal. In line with that both Diana defends herself (65) and Evan the group (66). The re-orienting knowledge making move with following actions (64, 65, 66) illustrate that 'to build' is the normal activity in this particular classroom; in another classroom context to discuss a solution for a long time would not have been considered to be doing nothing.

It can also be noted that the instructional knowledge move in line 67 normalises a new kind of student behaviour. Here the teacher gives the students explicit instructions for action, in contrast to the student behaviour she has endorsed earlier during the lesson, hence normalising a new way of approaching the building of the bridge and excluding student actions focused on e.g. discussion and testing.

Summary of epistemological moves

In our analysis we have distinguished between epistemological moves connected to the completion of the building task and the associated meaning making (knowledge moves) and moves explicitly expressing norms and expectations for student and teacher behaviour in relation to knowledge construction (knowledge making moves). In the table below we give examples of epistemological moves of various kinds that have been categorised as knowledge and knowledge making ones, respectively (Table 3).

Discussion

In this paper we have sought to complement an analytical approach to meaning-making founded in a transactional perspective (Östman and Öhman 2010) with Gore's (1995) operationalisation of a Foucauldian power perspective, thereby allowing for a more fine-grained understanding of how power operates by the embracing of certain teaching content, and in the demarcations and disarticulations of other.

By looking at how the teacher communicates what counts as (ir)relevant knowledge or (ir)relevant ways of acquiring knowledge, some themes emerge as to what kind of technology student is made desirable in this classroom. Given the limited empirical material these themes cannot be understood in a generalisable way, rather it is the methodological approach of moving from how certain epistemological moves create normalisations and exclusions to which kind of student this produces that we want to illustrate in the following. Further, given the continuity in the functioning of power relations in pedagogy shown by Gore (1995), transferability is likely to be a more appropriate measure of trustworthiness (Lincoln and Guba 1985). For our results, that is the extent to which we have provided a detailed enough description of our 'case' for comparisons with other contexts to be possible.

The desirable student in the classroom and the associated student subjectivities it opens up cannot simply be thought of in terms of either repressive or productive power. As Foucault (1980) argues, power relations are the precondition for our subjectivities and not only do they make us submit to certain norms, they also make subjectivities possible. For

Table 3 Examples of different identified epistemological moves, the numbers refer to the number of the excerpt and the line (for example, 6:67 is line 67 in excerpt 6)

Epistemological moves	Type I: knowledge	Type II: knowledge making
Confirming	4:36 Yes, you can do it [the construction of the bridge] like that	Not present in data
Re-constructing	Not present in data	Not present in data
Instructional	6:67 it has to be this long here, and then you have to decide	2:19 Because he is your friend or because you believe in what he said?
Generative	1:11 How are the lolly sticks the strongest? From which side?	1:14 I won't answer that, discuss it
Re-orienting	5:51 Are you able to place lolly sticks like that, so that it becomes strong?	6:1 What are you doing? Are you stealing ideas?

example, Anna Jobér (2012) has shown that students who are unaccustomed to scientific/academic discourse (in her case, students from working-class backgrounds) can find it difficult to decode the activities in the science classroom (such as, what is expected when participating in a discussion). Consequently, providing clearly framed activities could make certain school science subjectivities possible, that otherwise would be inaccessible. In the classroom we have observed teacher utterances that explicitly name how to act in this context are surprisingly abundant. Through the knowledge making moves the teacher makes the expectations on the students as well as on herself as a teacher explicit, by signalling how knowledge ought to be constructed in this technology classroom. The desirable student is constituted as a self-governing individual who constructs knowledge through discussions in the student group (using e.g. their everyday experiences as a reference) and through testing of the properties of the lolly sticks. Asking the teacher for correct answers is a practice that is explicitly excluded as is 'stealing ideas' (i.e. getting inspiration from the model bridge on the window sill). Explicitly excluded is also drawing a conclusion based on who said something, that is, the student is supposed to reason rather than rely on a friend's authority. Implicitly excluded, by the focus on discussions and testing, is, for example, the use of text books. Thus, the student groups are expected to independently reach a conclusion about how to build the bridge, relying on their reasoning rather than the teacher or textbooks, thereby producing meaning in a specific way. Taken together, this could be interpreted as the teacher socialising the students into a rationalistic norm, that you can reach a solution to the problem through pure reasoning (Lundqvist, Almqvist and Östman 2009). As discussed by Lundqvist, Almqvist and Östman (2009) this norm belongs to a classic epistemological tradition, that somewhat paradoxically also includes the inductive norm. In this norm experiences are viewed as the source of knowledge and, thus, making investigations becomes fundamental for knowledge construction. When the students are encouraged to test the strength of lolly sticks and triangles, when loaded in different ways this could therefore be interpreted as the teacher socialising them into an inductive norm. However, due to the limited materials provided, the students are not able to build any test structures, and in terms of ways of working the rationalistic norm thus gains precedence over the inductive norm in the studied classroom. Further, in the studied classroom, there is an ongoing normalisation of certain content knowledge, where particular kinds of knowledge are made valuable for a desirable technology student. This is exemplified by the questions that were frequently used by the teacher to direct the students towards important principles for construction that indicated what was most important to pay attention to in this context, which was solid mechanics, consumption of material, reference to everyday life and alternative ways of construction. In particular, the focus was on solid mechanics and the consumption of materials, whereas other potential aspects are excluded, such as aesthetic dimensions (which, despite being explicitly included in the assignment are not mentioned during the lesson). In focusing on the consumption of material the teacher can be understood as bringing the importance of adhering to the specification of requirement to the fore, something that can be considered an important technological content knowledge. This focus on the specification of requirements is part of a broader technological content knowledge concerning the interpretation within technology/engineering concerning the knowledge about the function of artefacts. In technology education the knowledge of functions of artefacts is more normative than in science education in that it emphasises what artefacts ought to do (Jones, Buntting and de Vries 2013). The teacher also communicates what counts as 'doing something', i.e. building a bridge. This focus on the end-product is interesting to explore

further as it could be considered a more pronounced characteristic of technology than science.

Previous research about power-relations in science and technology classrooms has largely approached the interconnectedness of power and knowledge by analyses that start in the power relations/interactions of the classroom, while to some extent taking for granted what participating in a discipline-specific discourse consists of. In doing so, the sub-practices that are conceptualised as the 'building blocks' of scientific practice (i.e. inquiry (Donnelly, McGarr and O'Reilly 2014) or subject matter (Reinsvold and Cochran 2012)) are not problematised, in terms of, for example, analysing how they get produced in interaction and/or which their constituents are. Here we have tried to approach the interconnectedness of knowledge and power from the other direction, by starting in a knowledge-based framework (Lidar, Lundqvist and Östman 2006). This approach rests on the assumption that what is made possible and legitimate in a classroom, in terms of knowledge as well as ways of knowledge-making, can be understood as an aspect of how power is productive. However, in a similar way to how previous studies of power in science and technology classrooms can be said to have foregrounded analyses of power-relations/interactions, and in doing so conceal the detailed workings of school science, our analytical foregrounding of the micro-level production of knowledge/knowledge-making is struggling to visualise the workings of power beyond isolated instances of teacher–student interaction. As we move forward in our research we wish to take the situatedness of the science and technology classroom seriously in exploring the construction of power/knowledge. Among other things, this implies a need to acknowledge, not only on a theoretical level but also in our empirical analysis, that what happens in the studied technology classroom is by no means isolated from surrounding structural factors (on school level as well as societal and disciplinary levels). At the same time we wish to be closely attentive to the micro level interactions, as 'it is precisely the mundane and subtle character of these practices' that according to Gore (1995, p. 169) 'contributes to the functioning of the pedagogical regime'. Given the limited empirical data made use of in this exploratory paper it is beyond the scope of our analysis to try to connect what happens in the classroom to surrounding structural factors. However, with a larger empirical material it would be possible to look for patterns in terms of, for example, in conversation with which students which epistemological moves are realised and how this contributes to whom is positioned as a technological/scientific authority. One such pattern that would be of interest is the potential gendering of technological/scientific authority. Could, for example, the equivalent of Frank's certainty and Diana's hopelessness in Excerpt 6 be traced through a larger empirical material? In terms of the challenging task of bridging the micro-level interactions of the classroom with macro-level structures another possibility is to consider what is governing the teachers' actions (including, but not limited to, curricula, local parental culture, and disciplinary culture). When could teacher actions, for example, be understood as the teacher self-governing in relation to a perceived disciplinary or pedagogical discourse? Traces of such broader cultural patterns, and how teachers self-govern in relation to them, might be visible in action. For example, when the teacher we have observed in Excerpt 2 says that she is going to leave the group before 'she says too much', this could be interpreted as self-governance in relation to a progressive teaching discourse, where teachers' are not expected to provide answers.

In distinguishing between two types of epistemological moves we have constructed a way of visualising how what counts as appropriate ways of getting knowledge in a specific practice is both communicated in direct (knowledge-making moves) and indirect (knowledge moves) ways. When combined with Per Anderhag's (2014) argument that

'teaching can make a difference to students' interest in science by explicitly orienting the process of interest towards scientific aims, making norms of the classroom a shared concern' (p. 68–69), we argue that it can be helpful for teachers to pay attention both to knowledge moves (which are likely to be part of any teaching practice) and to knowledge-making moves. Providing knowledge-making moves in conversation with students is one way of making explicit how students are expected to act within a particular disciplinary culture. This can be useful both in terms of socialising students into a particular disciplinary culture (an example in our case study, is not drawing conclusions based on who said something), but also for highlighting disciplinary norms a teacher wants to challenge and change. Similarly, the analytical pair of normalisation and exclusion provides a way to highlight the socialising aspect of education. Notice that exclusion, in the sense we have used it, should not be viewed as something that is negative *per se*, teachers' may well use exclusion to steer students away from unwanted knowledge or ways of knowledge-making. However, given that the epistemological moves we have classified as exclusion do not provide the students with much guidance as to what to do, they mostly provide guidance as to what not to do, they may be of limited usefulness to the students. An interesting continuation of our study would therefore be to analyse the productivity of student-to-student interactions following teacher–student interactions that has been predominantly normalising or excluding.

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